June 9, 2009

Subaqueous Soils Working Group
NCSS Interpretations Standing Committee
National Cooperative Soil Survey Conference
Las Cruces, NM
May 11 -15, 2009
FINAL REPORT

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Introduction

Subaqueous soils are regarded within the National Cooperative Soil Survey as an emerging topic sufficiently developed to warrant inclusion in soil survey activities and products. We need to solidify the framework for the mapping, classification and interpretation of these soils to begin to include these in soil survey activities. The purpose of this working group is to document the status of subaqueous soil mapping and to further establish the information needed to make these soils a part of regular mapping procedures.

Much of the previous effort in this area has been in the areas of mapping and classification of subaqueous soils; but a framework with interpretations is required as the ultimate product. During discussions in the Interpretations Standing Committee at the 2007 National Cooperative Soil Survey Conference in Madison, WI, Texas Soil Survey proposed development of national interpretations for subaqueous soils. They requested that, at a minimum, the Interpretations Committee at the 2008 NCSS Regional Conferences be directed to develop a preliminary list of subaqueous soil interpretations and criteria that could be used to derive interpretative ratings, if applicable within each region. This Subaqueous Soils Working Group is the result of that interpretations request.

Members and Contact List

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2009 CHARGES FOR WORKING GROUP

This subaqueous working group for NM NCSS meeting explored and discussed how soil survey should address subaqueous inventory interpretation and classification. The charges of the workgroup were:

1. **Review and document progress from 2008 regional conferences on subaqueous soils**
2. **Institutionalize methodologies for sample handling protocols and characterization methods for critical data elements**
3. **How might studies of regional or local hydrology apply to mapping and updating freshwater subaqueous soil survey information?**
4. **Document progress of subaqueous soils research in soil survey and applications to interpretations.**

Charge 1. Review and document progress from 2008 regional conferences on subaqueous soils

From Northeast Region (2008):

https://sharepoint.ngdc.wvu.edu/sites/NER-NCSS_Conference/2008%20Conference/Committee%20Reports/2008_NENCSSC_Stolt_Subaqueous_Soils_Recommendations.pdf

Charge 1: Proposed revised definition of sulfidic materials for Soil Taxonomy.

Sulfidic materials definition was discussed in Standards meeting in NM.

Charge 2: Subordinate distinction for horizons with sulfides

Charge 3: Thickness of sulfidic horizon for use for classification purposes.
This change was made to the taxonomy Mark Stolt distributed.

Charge 4: Proposed amendments to Soil Taxonomy to accommodate subaqueous soils.

Charge 5: NASIS proposals focused on Subaqueous Soils

Charge 6: Additions of landform, landscape unit, and anthropogenic feature terms to subaqueous soils glossary and NSSH;

New terms included, and new ones will be added over time.

Issues that were considered in 2008 Northeast meeting:

1) Proposed revised definition of sulfidic materials for Soil Taxonomy (Del Fanning).

Proposals were submitted to NRCS Standards Committee for incorporation into Soil Taxonomy; are finalized**.**

2) Subordinate distinction for horizons with sulfides (Mark Stolt)

si= sulfidic materials: This symbol indicates the presence of sulfidic materials in mineral (and organic) horizons. These soil materials typically have a black color (associated with mono-sulfides) that changes color almost immediately following the application of weak (3%) hydrogen peroxide, and/or have a moderate to strong hydrogen sulfide odor. Incubation pH values are <4 after 16 weeks or more of moist incubation. The "si" is used primarily in subaqueous and very poorly drained tidally influenced soils.
The committee agreed that the symbol is needed. Discussion focused on several issues: Is "si" the best to use? Or could other symbols be used. "s" and "i" are never used together so one is used for organic soils and the other mineral. Sulfides has an "s and an "i" in the word, so seems appropriate; thus, should be able to use for organic soils if they meet the criteria of sulfidic materials. What strength of peroxide is necessary (3, 10, or 30%)? Are there other morphologic characteristics that we could use? (none were suggested)

3) Thickness of sulfidic horizon for use for classification purposes. (Mark Stolt)
Most agreed that some thickness should be required. The thickness was debated. 15 cm was agreed upon. In Soil Taxonomy proposal.

4) Proposed amendments to Soil Taxonomy to accommodate subaqueous soils.
Similar concerns were voiced at the meetings in 2006 and previous recommendations will be followed. Stolt will consider the comments and suggestions from other regions and adjust accordingly. Keys will be published by Jan, 2010.

5) NASIS proposals focused on Subaqueous Soils
Proposals that have been sent in to the NSSC for adding attribute information to NASIS and Pedon PC for subaqueous soils.

a) Manner of Failure Proposal
Already accepted. Rabenhorst suggested the n-value equation or values should be investigated some more based on recent findings.
Most proposals have gone through and will be included in NASIS Ver. 6.0. Subaqueous definition, n value, manner of failure update definitions, oxidized pH will be included as data field.

b) Oxidized pH Proposal
Will be added once the proposed revision to the definition of sulfides is accepted**.**

c) pH Oxidized Laboratory Method
Change and add.

d) Reaction to Peroxide Proposal
See “si” horizon designation.

e) Multiple Primes Proposal
Will be included in NASIS.

f) Mean Water Depth Proposal
Suggested that depth be recorded as part of the profile description, as well as elevation. The depth should be a phase attribute in the mapping unit.

6) Additions of landform, landscape unit, and anthropogenic feature terms to subaqueous soils glossary and NSSH
Terms have been reviewed, proposed, and incorporated into glossary and handbook**.**

7) Proposed new Drainage Class
Subaqueous is now used.

8) Measurement of Salinity/Conductivity
Any labs performing characterization of subaqueous soils should be aware of these issues. Work needs to be done on this. Nothing is in NASIS yet

9) Salinity Class
New terms were necessary. Suggestions will be entertained and reviewed.

10) Annual Average Water Temperature
Needs further investigation; nothing in NASIS yet; what depth needs to be recorded, should be near surface (25 cm below the soil surface)

<u>From Southern Region (2008):</u>

<u>Charge 1</u>: Identify Subaqueous Soil Interpretations and Required Soil Properties

<u>Charge 2:</u> Develop a list of actual/potential customers who need these interpretations

<u>Charge 3</u>: Define vision/process to develop Ecological Site Descriptions for subaqueous soil map unit components

Recommendations:

- Revisit the USDA/NRCS definition of soil (Soil Survey Staff, 1999) to determine if it is adequate and compatible with the planned activities of extending soil survey into aquatic areas. Jim T suggests the <2.5 m depth be changed to 4 m to be inline with what EPA uses for the cutoff for "Shallow Water" environments. This depth is similar to what we have found the cut-off depth for SAV in Northeast.
- Address the bounding of soil at deep water: what is conceptually correct, what is logistically possible, what is meaningful for the users, what is practical for the USDA.
    - Under the CMECS subbenthic component the taxonomic system can be expanded to deep water – seamless data.
- Address issues of map scale with respect to: users, meaningful interpretations, feasibility of mapping, natural variability, and compatibility with current Soil Survey data.
    - Most NRCS mapping is at 1:12,000 but order 1 surveys have been done in past.
    - In RI, they regard that a good scale is 1:6,000 to 1:10,000
- Address standards (e.g. mapping and laboratory). Are the current field and laboratory methods adequate for subaqueous soils?
- Recommend a regional workshop development of a draft
- Develop a subaqueous soil ESD with proposed ESD structural changes.

Conference ideas well received; three projects on going in FL (Keys (Lake Surprise), Indian River Lagoon (Johnson seagrass and other seagrasses), Riverine area (freshwater and some tidal areas) along Gulf of Mexico (Tom Saunders) final report being written.

Univ. Florida Library (available online): Rex Ellis PhD work; Kelley Fischler thesis in Kelley Island; Gulf of Mexico (Tom Saunders)

From Subaqueous Committee in Corpus Christi, TX (2005):

Charge 1. Review proposed new terms for describing landscapes, landforms, and parent materials of subaqueous environments.

Charge 2. Review the draft handbook of subaqueous soil mapping procedures.
Mark worked on initial document (5-7 pages); since then, has added new methods and instruments have been used. Need document with more details; equipment, sources, ect. Likely make into an SSIR report. See the publication *41 North* from New England. Want to include in Soil Survey Manual but the SSM may be awhile, target date 2010, but no one to work on it.
RI is working on the methods document, plans were discussed at 2009 NCSS meeting to publish as a Primer, once RI is near completion the draft will be sent – folks should send any input or items they would like in the document.

Charge 3. Recommend action to be taken by the National Soil Survey Center Staff for these two documents.

Recommendations:

- The draft glossary was adopted within the NCSS. The National Soil Survey Center Staff has taken the necessary steps to add these terms to NSSH Part 629 as well as future releases of the NASIS and PEDON program choice lists and Field Book for Describing Soils. As new terms are needed, they should be proposed for inclusion to NSSH 629 through the Soil Survey Investigations Staff at NSSC.
- The Procedures Manual should continue to be worked on by interested committee members. Mark Stolt has agreed to continue to take the lead in moving this forward.

Charge 2. Institutionalize methodologies for sample handling protocols and characterization methods for critical data elements

From Southern Region Report (2008):

Minimum property set: the following properties and morphology are necessary to generate interpretations of subaqueous soils:

• Particle Size Distribution: presumably sand, silt, clay by pipette along with sand subfractions.
• Carbon Content: organic and inorganic fractions either by weight loss after combustion or using a TC analyzer and acidification.
• Sulfides: various sulfide measurements can be made, such as moist incubation, total sulfur, acid volatile sulfides, etc. Each method provides specific information about sulfur.
• Bathymetry: important in determining water depth, soil landscapes and landforms, elevation, geography (which controls tidal amplitude), and potential exposure or water depth on low tide.
• Vegetative Cover: It should be noted whether the soils actively support or have the potential to support SAV. The SAV potential of subaqueous soils is difficult to assess.
• Bulk Density / *n* value: *n* value is determined by hand, while bulk density would be measured by coring and weighing the soil.
• Soil Color: field determination using a Munsell color book.
• Redox: IRIS tubes, platinum electrodes, and observations of soil colors

From Northeast: Methodology of subaqueous landform mapping

  - Mark/Mike paper on creating bathymetric map.
  - MapCoast working on methodology paper something for National Soil Survey Manual
  - Vibracore procedure
  - Cost list and sources for equipment needed.
  - Procedure on deriving products from the bathymetry and how to break out landscape units.
  - Work on predictive mapping – SOLIM, etc.
- What data is important to capture?
  - Spatial distribution.
  - Surface data (bouldery phases, shell hash (oyster restoration), texture.
  - Benthic habitat
  - Shoreline type (anthropogenic features, shoreline protection structures)
  - Bathymetry and acoustic (side scan) map of bottom.
  - Water column attributes – YSI readings, secchi disk
  - Pedon descriptions – field note data (hand tools) and detailed core descriptions.
  - Lab data – PSDA, OC (inorganic), BD, AVS/CRS, pH drop, EC, metals, more.

    - Organisms identified in the cores. (need descriptive topics and terms for benthic surface features observable from the image (e.g. tube worm burrows or spoil)
    - Video. Still image of the bottom for each core (similar to a landscape photo for terrestrial).

- Documentation of sample collection/procedures
    - RI has a spread sheet for field note entry can provide.
    - Lab analysis
- Development of procedures manual

    RI working on this should have something out by summer.

Recent issues:

Sampling tools - What other sampling systems besides vibracores are being used that cause less disturbance to the soil fabric? Vibracores can cause soil in the tube to become fluid due to the vibration and render the sample useless for some geotechnical analysis. For highly fluid and organic soils a piston corer (biologic core) provides an undisturbed sample. Vibracore does cause some settling (core rot) but measurements should be taken of the core before to determine the amt of settling. McCauley works well along with other types of coring (Thompson corer, etc). Can also use bucket augers, Dutch auger, etc.

How are safety issues related to contaminants in SAS being handled? Possible contaminants include mercury, PCBs. and others. How can they be mapped or included in classification? Or can you "phase" them in mapping? Currently, the best precaution is use of gloves (if contamination is suspected) or routine washing hands for routine sediments. No difference to folks mapping landfills. If highly contaminated like some of the river areas under investigation (material bubbles in the McCauley when exposed to air), then only visually examine or use haz mat suit.

How can SAS that have high levels of phosphorus and/or nitrogen from agricultural runoff be characterized in the proposed classification scheme? **Phosphorus—may need total and a specific extract (check marine biologists techniques); what are sinks and sources; understand sedimentation rates.** If those elements in the soil are of concern for the area or interps this information should be added to the workplan or soil survey investigation plan when sending the samples to NSSL. Also look at correlation of high N&P with invasives (Milfoil, phrag, etc.).

Trace metals identified as a need in the analytical protocol; need to identify baseline levels.

Series criteria and series differentia—could we use P to define series ranges; much of the separation criteria may be chemical; what are the materials and how do they sequester P.   Would it be part of phase criteria? What criteria is allowed (right now is water depth). How to differentiate for freshwater sites (what criteria are needed)

How do these fit into the MLRA structure? How to start project? Is subaqueous part of MLRA update in future?   Need to build interest. Want subaqueous soils as part of routine work in MLRA office.

Possibly tie into web soil survey on some work from subaqueous.

What are important interpretations needed that may drive phase criteria?

Charge 3. How might studies of regional or local hydrology apply to mapping and updating freshwater subaqueous soil survey information?

In RI work has begun on mapping and inventorying shallow fresh water bodies that were formally mapped as water where less than 40 acres or UNMAPPED areas where > 40 acres (pond named). Bowdish Reservoir (see below) and Sawmill Pond surveys are good examples.

Subaqueous Soil Survey of Bowdish Reservoir – Gloucester, RI.

Background:
The RI NRCS is looking to partner with the state DEM to address resource concerns in several fresh water ponds and lakes in Rhode Island. As part of collecting baseline data to address concerns such as invasive species management, habitat restoration, and restoration of the water bodies the subaqueous soils of Bowdish Reservoir was mapped during the winter of 2009. The RI NRCS soil staff employed ground penetrating radar (GPR) techniques to profile the subsurface of the pond bottom to determine information on the substrate. Several cores were taken to classify the soils and ground-truth the radar data. A preliminary soil survey maps of the pond was then produced from the GPR data.

The next step for the pond will be collecting detailed bathymetry to produce a contour plot of the water column, collect water quality data using a YSI meter, and mapping the SAV and bottom type. This is planned for spring of 2009.

Equipment:
Several GPR units including a SIR-3000 with GPS interface and a SIR-2000 were used for the survey; antennas included a 120, 200, and 70 MHz. Information on GPR can be found at: http://nesoil.com/gpr. Coring equipment included a McCauly peat corer and steel rods.

Bowdish Reservoir (Pond):
Bowdish Reservoir is a 226 acre water body located in the George Washington Management Area in Gloucester. It is a human-made embayment controlled by a dam located in the NW corner of the pond. The average water depth is 5.6 feet with a maximum depth of 11 feet. During the survey the water levels were approximately 3-4 feet below the high water mark. The pond has a heavily weeded bottom with numerous cedar stumps outcropping in the east basin.

Survey Results:
Results from the GPR survey showed most of the pond consists of very deep peat deposits typical of a kettle-type pond. Peat thicknesses up to 42 feet occurred in the east and west basins. A contour plot of the peat/mineral interface is provided in figure 1. The volume of the peat deposit within the pond is estimated at 84,000,000 cubic feet (based on volume from grid using SURFER). The maximum profiling depth of the GPR was 20 to 30 feet depending on the antenna. The radar also showed many anomalies in the profile interpreted as buried cedar stumps and branches (confirmed by ground-truthing) and also the stratigraphy of the underlying mineral deposits which included bedrock, boulder till, and stratified material.

Soil Survey:
Figure 2 is a draft copy of the soil survey map for the pond. This was mapped using the GPR data, ground-truth, and soil core logs taken during the survey. To help delineating the shoreline (submerged beach units) the pictometry images from Live.com were used along with 2008 4 inch true color imagery. The soils identified in the pond consists of three main types – very deep organic soils

Figure 1: Contour Plot of Peat Thickness (2 foot contours starting with -2 feet)

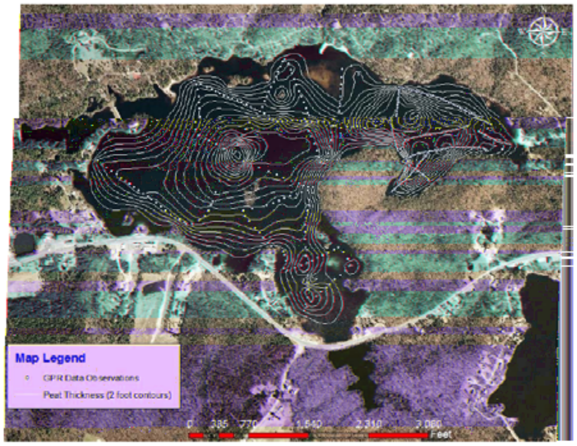


Figure 2: Soil Map of Bowdish Pond – landscape units

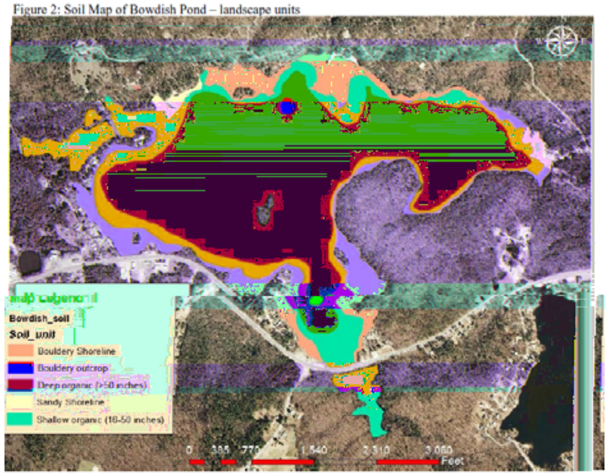
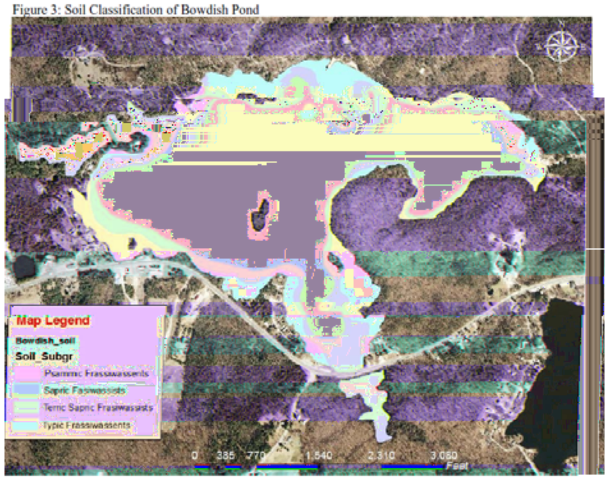


Figure 3: Soil Classification of Bowdish Pond



GPR techniques provide very useful data in fresh water systems. Mapping is done using similar techniques as estuarine areas. Ground-penetrating radar is an excellent tool to determine substrate info and bathymetry. Many of the ponds in RI come out as Frasiwassists (and terric great groups). The need and use for this data is for invasive species control (use of herbicides and fate of movement vs. drop down, freeze, and raise to pull the roots of Milfoil) , baseline info on soil and bathymetry – no existing data on ponds is available via spatial map or point data, use for restoration – volume of soft material, accretion rate of pond, metal accumulation, dam removal, carbon estimates (possible fuel source, basin volume), recreation, species/habitat (a Freetown submerged, very stumpy map unit = habitat for turtle, deep basin = bass), water volume, etc. I actually get more requests for fresh ponds than estuarine areas so there is interest. Need to get an idea of acreages of fresh water, difficult without any existing data.

Interest in PA, MN, great lakes area; need to expand list of contacts; Where do hydric soils end and subaqueous soils begin; Planners are starting to work on invasive species, needed for farm bill programs. NRCS and recovery and investment act – received $$ for floodplain work.
Older reservoirs that are filling with sediments, now are subaqueous soils.

Texas- One application may be playa lakes that are intermittently wet (some year round; some never wet), although this application is unlikely due to the ephemeral nature of ponded water on these natural landforms. Also, freshwater lakes in City of Lubbock, catch city runoff – consider anthropogenic landforms on which we might map subaqueous soils, including reservoirs, man-altered playa lakes, etc. . Check Wassents definition for subaqueous soils in terms of what meets definition (need positive water potential 21 hrs per day and every single day).

ACWI National Groundwater monitoring network—Amer. Assoc. of State Geologists; check relevant to freshwater systems. We have a MOU with them.

NOAA very interested in coastal area mapping.

Freshwater systems may break out well on the MLRA boundary.

Vermont--Is moving ahead with initiating a freshwater SAS mapping project that will most likely include mapping of bays in Lake Champlain and other selected water bodies in the state. We have been meeting with potential partners this past winter and spring and plan to host a small gathering of interested parties most likely in September. There is already an impressive infrastructure in place for supporting this type of work in the state.

Charge 4. Document progress of subaqueous soils research in soil survey and applications to interpretations.

Full list of potential Interpretations needs to be generated. Possible interpretations include:

- SAV Restoration
- Crab Habitat
- Aquaculture/shellfish restoration
- Management for Sustainable Production - Shellfish
- Nutrient Reduction/Health/Water Quality
- Benthic Preservation Site Identification
- Wildlife Management
- Critical Habitats for Wading Shore Birds
- Nurseries and Spawning areas
- Habitat Protection for Horseshoe Crabs
- Dredging Island Creation
- Tidal Marsh Protection and Creation
- Bathymetric Map
- Navigational Channel Creation/ Maintenance
- Effects of Dredging on Benthic Ecology
- Off Site Disposal of Dredge Spoil
- Acid-Sulfate Weathering Hazards
- Dune Maintenance/Replenishment
- Accretion rates.
- Phorphorus source/sink
- Heavy metals/Health Issues.
- Archaeological – pre-historic landscapes.
- Energy production – wind farm sitting.
- Baseline data.
- Habitat Mapping
- Classification of soils.
- Wetland delineation
- Coastal Soil Data
- Impacts of sea-level rise
- Survival of seagrass
- Risk/ susceptibility of invasive species (e.g., milfoil)
- Herbicides use and movement
- Mooring/anchoring suitability
- Piling installation and stability

See the list of interps and status used in the northeast at:
http://nesoil.com/sas/2009_Master_Interpretations_Table.doc

Write up proposals of what data needs to be collected. What can we do to upgrade maps

How do we deal with turbity? It will affect interps. Salinity, depth, other issues as well. Water characteristics above the soil are important to interps.

We currently do not know enough about what characteristics are important for certain interps. Will need to gather the data, but the info is not there.

We don't populate water layers unless it is in the soil. Procedure needs to be modified in NASIS because it does not recognize water layers above soil. Subaqueous drainage class may help.

Additional Working group Issues

We must stimulate cooperation/coordination among regions. Development of the science requires input of users from various geographic areas. Need funding from sources beyond the state level to facilitate research and development of mapping and interpretations; possible NRCS funds? Need to consider survey of potential customers (state agencies, federal agencies, non-profit agencies, consultants, etc.) to determine their needs in relation to subaqueous soils.

Definition of Subaqueous soils and application to all areas

Subaqueous Soils-Alaska Perspective (Mark Clark, NRCS, AK)

The addition of subaqueous soils to Soil Taxonomy will have a significant impact on soil survey program in Alaska since our state has a majority of the wetlands in the United States. Wetlands and deep water habitats comprise over 204 million acres of Alaska with wetlands alone covering 175 million acres or almost half of the State compared to 103 million acres for the entire lower 49 states. Over 30 million acres of deepwater habitats would potentially be added as "soils" based on the definitions as proposed for subaqueous soils.

Over the past 15 years NRCS in Alaska has been providing Ecological Site Inventory information to our partners. Large areas of the state are covered by rock and ice as well as fresh water bodies and coastal environments. A fundamental and pragmatic definition of soil is essential to planning soil survey activities with all of our partners. Alaska NRCS has developed a functional definition of "soil" built upon that provided in Soil Taxonomy (2nd edition) in order to provide consistent information to our clients. Field scientists need a succinct working definition of soil so as to avoid potential misunderstanding regarding the extent and detail of information that will be provided as products of a soil survey. A functional definition of soil helps us to focus our efforts in our areas of expertise and direct our clients to other more qualified groups when the type of information that they request is beyond the scope of the soil survey program.

After reading the definitions proposed for subaqueous soils, it seems like the core intent is to cover only the estuarine areas subject to tidal influence and freshwater habitats. However, the definitions as worded open up everything including emergent, submergent and shallow water habitats for possible inclusion. Problematic areas that need omission from the definitions include shallow freshwater lakes, kelp beds, and areas of submergent vegetation controlled more by hydrogenic rather than pedogenic processes. I encourage the committee to refine the definitions to include only the shallow tidal estuarine areas and freshwater habitats <u>with</u> emergent vegetation. A practical definition of soil built upon the current definition in Soil Taxonomy and discussion of specific issues associated with the proposed definitions of subaqueous soils as used in Alaska is provided.

A two part operational definition of a soil is used by soil survey in Alaska to distinguish soil and non-soil areas:

1) All soil forming factors must be present and accounted for with the caveat that not all factors are of equal importance in all soils.

- Areas dominated by emergent vegetation are considered as soil.
  - Common genus: Typha, Scirpus, Carex
- Areas dominated by submergent vegetation are not considered as soil.
  - Common genus: Elodea, Zostera, Macrocystis
- Areas dominated by non-vegetated ice, rock, and gravelly alluvial material are not considered soil.

2) Soil bodies can be identified and consistently delineated using generally available resources including aerial photography or high resolution satellite imagery and can be sampled and described using basic field tools. Ecological sites may be determined and documented by Soil Scientists and Plant Ecologists.

NRCS-Alaska considers that all five soil forming factors be reasonably accounted for before we consider an area to qualify as soil. This can be a problem in areas where wetlands grade into deep water habitats. In Alaska, we consider the soil-deepwater edge to correspond to the outer limit of emergent vegetation. A specific example is South-Central Alaska estuary wetlands dominated by emergent vegetation consisting of bulrush (*Scirpus spp.*) with a soil that is classified as a Terric Cryosaprist. Physiological function of the bulrush community includes interaction between the atmosphere, water system and the soil. The hydrologic regime, soils, as well as the climate are equally important and define the type of plant community adapted to site. If we were to examine a similar community within the Western Maritime or Arctic Coast Climatic Zone, we would expect a change in the composition of the existing plant community that would reflect differences in regional climate. In other words, climate is an active driver on this site as well as the other four soil forming factors. Soil scientists and Plant Ecologists can reasonably quantify these differences using remote sensing and standard field sampling techniques.

However, if we examine several submergent plant communities we will find that these communities are rarely sensitive to regional climates. An example is the distribution of one of the most extensive freshwater submergent species in North America, the common waterweed (*Elodea canadensis*). This species grows in subaqueous communities, usually as a monoculture, from Maine to California regardless of differences in regional climate and general soil temperature zones. These communities are not the product of all five soil forming factors, but controlled by hydrologic conditions, specifically submerged freshwater conditions with relatively high concentrations of calcium in the water. A particular substrate may be necessary in terms of physical properties for anchoring purposes, but a vast majority of nutrient requirements are met through specific hydrologic conditions in the water column.

Submergent saltwater and estuarian communities are no different. Kelp grows in saltwater ranging in depth from 2 to 45 meters. Productive communities of kelp are found from Baja California to western Alaska and are controlled by water temperature and nutrients controlled by ocean-wide currents and the presence of a firm substrate. Kelp extracts all nutrients from the water and requires a specific substrate, rock or coral for its roots or “holdfast” which serves only as an anchor, not a mechanism for nutrient uptake. Eelgrass (*Zostera marina*) is adapted to the shallow cold waters of the North Atlantic, as well as the mid to high latitudes of the Pacific Ocean from the Baja to the Bering Sea. One of the largest areas of eelgrass identified in the world (40,000 acres) is in Izembek Lagoon on the north side of the Alaska Peninsula in the Bering Sea. Even modeling the mechanism of uptake for eelgrass is focused more on the water column and transport within the plant than the substrate in which the plant is anchored. Based on the wide distribution of this species, ocean circulation patterns are more influential than regional climate on the distribution of this species. The climate factor is basically non-influencing and therefore these sites do not meet our definition of soil. These examples underscores the fact that most commonly occurring submergent plant communities are controlled by aquatic conditions without significant pedogenic influence and therefore are considered beyond the expertise and scope of the soil survey program in Alaska.

Soil Scientists and Plant Ecologists must be able to consistently observe and document the extent and variation of communities using aerial photography or high resolution satellite imagery to delineate soils. This is possible in areas of shallow water with emergent plant communities where distinctive photo signatures are present. However, detecting the presence or absence of submergent communities is problematic and delineating various submergent communities for the purpose of Ecological Site Inventory is not possible with commonly available imagery. In addition, minimum field documentation standards to support soil components and ecological sites within submergent plant communities would not be attainable due to access and logistical issues. This would include a large portion of the 30 million acres considered as deep water habitats in Alaska.

Document public benefits from having this type of mapping/interpretations

Bottom line – resource inventory maps are fundamental for planning current and future uses of an area. Although geologic maps for shallow water environments are available in some areas, little or no soil maps are available for these shallow water areas and existing maps we made pre-technology revolution and nothing is more useless than an outdated map!

Each year millions of dollars are spent by State, Federal, and Non-profit organizations for coastal restoration efforts, the success or failure of these efforts is dependent on good data and mapping available during the planning stages. It is hoped by providing this data will save expenses and improve the outcome of the restoration effort.

The need for better mapping of coastal resources, particularly critical fisheries habitat, was deemed the highest priority by the Rhode Island Environmental Monitoring Collaborative that was created by the General Assembly and Governor in 2004.

The 2004 U.S. Commission on Ocean Policy report has identified the need for “accurate and seamless living and nonliving marine resource data with bathymetry, topography and other natural features across the shoreline, coastal zone, near shore areas, and open ocean waters” (Recommendation 25-7).

This unique integration of existing terrestrial and aquatic datasets provides powerful information for scientifically-based management of coastal activities such as dredging, fishing, and conservation. In addition, the integrated approach of watersheds with their downstream estuaries or nearshore environments provides a powerful tool for land-use planning and resource management.

Coastal Soil and Sediment Mapping Helps us Better Manage, Protect, and Restore our States Marine Landscape

Estimate acres of subaqueous soils
Show impact of time, cost
There are 400,000 acres estimated in RI for coastal areas only, additional for fresh water. In RI, 5,920 acres of “w” mapped not many more bodies > 40 acres are mapped as pond name and not included.
A low estimate of 3 million acres from Chesapeake to Maine for estuarine areas that NOAA has good bathy available – does not include shoreline or other embayments.
Extent of seagrass beds (submerged aquatic vegetation) along the Texas Gulf Coast covers approximately 250,000 acres and potential acreage for mapping subaqueous soils would be much greater. Fresh water subaqueous soils would potentially include both natural lakes and man-made reservoirs.

Ecological Site Descriptions (ESD) and database
The Grazing Lands Team headquartered in Fort Worth has assisted Texas with the development of an approved ESD for tidal soils, Arrada, Barrada, Tatton, and Satatton series, (Wind Tidal Flat PE 31-44, R150BY716TX) and a draft ESD for our only subaqueous soil, the Baffin series (Subaqueous Grass Flat 150BY728TX); their approach is potentially applicable nationwide. The Grazing Lands Team is interested in hosting a national forum on subaqueous soils for ESD development during FY2009 or FY2010.

CT NRCS did a pilot project on ESD, not sure of the use/demand.

Texas Soil Survey held a net conference with the Grazing Lands Team in May 2008 to discuss ESD development for subaqueous soils. Potential needs and protocol development for subaqueous soils ESDs were discussed.

Should the ESD protocol for saline/ brackish subaqueous soils be the same protocol as for fresh water subaqueous soils? Probably not. This task needs to be addressed. Need reference state (plant communities) to help establish ESDs and interps. Need to fully understand the plant side. Need to understand the potential. Disturbances that move the soil away from the reference community need to be defined. What is a healthy system?

How much work is there to know where breaks occur in ESDs in subaqueous soils? Probably do not follow our current temperature regime breaks nor the MLRA breaks. Also, are ESD breaks related to water depth and water quality?

Changes in NASIS to accommodate subaqueous soils
Need input on development of a NASIS minimum dataset for all states that have the potential to map saline, brackish, and fresh water subaqueous soils. Need to add more

as work expands. Possibly form a NASIS group for subaqueous soil data – it would be good to have a way to be able to pull all existing and future pedons, DMUs, etc. for use with analysis tools.

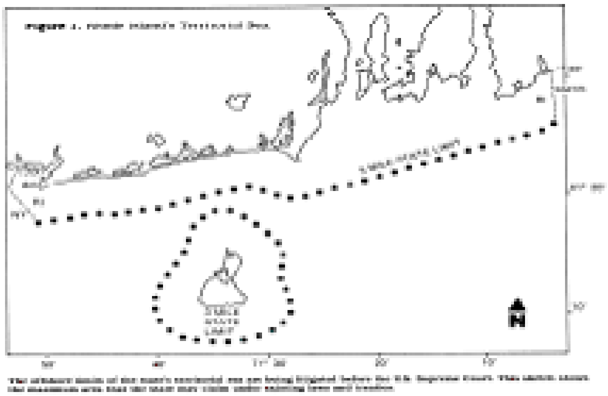
A 2nd National SAS Workshop
Summer, 2010 is being planned; potentially in Rhode Island.

What, if anything is the west coast doing on SAS? During the Restoring America's Estuaries conference we hosted a boat tour of our MapCoast work and several folks from Puget Sound were interested and asked why not in their area.

2009 Seagrass Conservation Workshop
June 11-12, 2009, Texas Parks and Wildlife Department, in partnership with the Coastal Bend Bays and Estuaries Program and the Port of Corpus Christi, will host the 2009 Seagrass Conservation Workshop. This workshop will provide a comprehensive look at the accomplishments of the original Seagrass Conservation Plan, identify unfulfilled and new objectives, and explore future actions and partnerships to further the protection and conservation of seagrass communities along the Texas coast. This meeting is expected to draw over 150 attendees representing governmental, academic, private, and non-profil organizations. As a goal of the workshop, the workgroup seeks partnership and cooperation from organizations who share in the mission of the Seagrass Conservation Plan. This type of meeting provides an opportunity for SSD to interact with persons and agencies potentially interested in subaqueous soils, and also afford a contact list for a "survey of customer needs" for subaqueous soil mapping.

Authority
Who owns/manages these subaqueous soil areas, and whether the NRCS is authorized, by statute, to conduct soil surveys there. If owned by private or state interest, then probably "yes", but if owned/managed by federal government agency, can we (NRCS, not the NCSS) expend funds allocated for private lands conservation to inventory these areas. Also, perhaps it should be asked are there social or environmental issues that should be considered in compelling cross-jurisdiction funding for soil survey activity (mapping or update).
The issue as it applies to Rhode Island (and likely other states as well) is that all tidal lands out to three miles are in state jurisdiction. Federal is anything more than three miles from the coast. They use the MHW line and there are some ways to extend state jurisdiction by counting little island within the three miles (that's a complicated part of the answer, and usually is of interest when there are mineral resources in dispute). The land is held in the public trust by the state, so short answer is we all own them.

Figure 1. Rhode Island's Territorial Sea



The offshore limits of the state's territorial sea are being litigated before the U.S. Supreme Court. This sketch shows the maximum area that the state may claim under existing laws and treaties.

RI NRCS has EQIP contracts in shallow water areas for eelgrass restoration, aquaculture, and shellfish restoration – the need for SAS data stems from the farm bill programs so that should give us the authority to map.

<u>Established SAS soil series</u> -
CT has 6 proposed, RI have about 7 in the works for sub-tidal soils, 5-6 in mid Atlantic. See the following link:

http://nesoil.com/sas/Proposed_OSEDs.htm

<u>The following list is from the website.</u>

Proposed Official Soil Series Descriptions for Subaqueous Soils in MO-12

Pishagqua - Fine-silty, mixed, superactive, nonacid, mesic Typic Sulfaquents (Lagoon Bottoms, low energy basins, 100 plus cm of highly fluid silts (organic silts).
Anguilla - Sandy, mixed, mesic Haplic Sulfaquents (sandy marine deposits over outwash)
Napatree -Coarse-loamy, mixed, subactive, nonacid, mesic Aeric Endoaquents (submerged terrestrial soils with a capping of sandy marine deposits)
Pequot - Mixed, mesic Typic Psammaquents (formed in sandy marine deposits)
Rhodesfolly - Sandy, mixed, mesic Typic Fluvaquents (sandy marine deposits with multiple buried horizons)
Wamphassuc - Coarse-loamy, mixed, subactive, nonacid, mesic Haplic Sulfaquents (loamy marine deposits underlain by organic material)

Wequetequock - Coarse-loamy, mixed, active, nonacid, mesic Typic Sulfaquents (loamy marine deposits underlain by organic material)

Proposed Official Soil Series Descriptions for Subaqueous Soils other areas

Demas - Siliceous, mesic Typic Psammaquents
Southpoint - Fine-silty, mixed, subactive, nonacid, mesic Thapto-histic Sulfaquents (Silty terrestrial tidal marsh sediments underlain by paleo-terrestrial organic deposits)
Sinepuxent - Coarse-loamy, siliceous, subactive, nonacid, mesic Typic Sulfaquents (Mixed dredge spoil materials)
Whittington - Siliceous, mesic Typic Psammaquents (Barrier island washover sediments)
Tizzard - Sandy over loamy, aniso, siliceous, subactive, nonacid, mesic Sulfic Fluvaquents (Barrier island washover sediments overlying loamy paleo-terrestrial tidal marsh deposits).

Retaw - Fine-loamy, mixed, superactive Typic Cryaquolls (freshwater)

Freshwater subaqueous series do not exist except the ponded phases of Freetown and Swansea soils (MO-12) these can be easily modified to be Frasiwassists, etc. Will most likely need the gamete of freshwater from sandy, loamy, to clayey, high n-value ones, Holocene underlain by glacial contacts, loess (well not in northern New England), and the histosols.

It would be good to set up a subaqueous soil group in Pedon so all the SAS soils can be queried and used in Analysis PC, once Wassents/ists is in taxonomy you could query the OSDs that way.

Are the SAS soil series established or proposed effectively narrow enough in their range in characteristics to be suitable for the needs of potential users? The proposed series narrow enough - not sure right now that is true as the map unit phases are set up but no one knows, but are terrestrial soils narrow enough for all these new interps coming online (Military interps, biohazards, etc.) - no.

Mapping scale for SAS mapping The preferred scale in Rhode Island for coastal lagoons is 1:10,000 or larger (1:6K best) but order 2 soil surveys are 1:12,000. Also special feature symbols can be used such as shell hash for old oyster reef/deposits - very important for oyster restoration to show on map where hard bottom structures are.

Recommendations from NCSS Meeting

1. Partners in SAS - Strengthen partnerships with other agencies (NOAA) and state DNR's. Identify customers (within federal, state, and local government along with private industry and non-profit organizations) and solicit mapping and interpretive needs from those customers.

2. Maintain working group and evolve into/formalize a national committee on SAS.

3. Develop SAS informational primer, tech notes, information sheets to explain concepts and create understanding of the purpose, mechanisms, and products.

4. Develop Methods Manual to map and characterize SAS properties – into SSM, NSSH, and into separate document

5. SAS Workshop – Organize to help standardize techniques/methodology—teach principals applicable to various regions.

6. Ecological Site Description – create small working group with ESD and SAS personnel to explore the possibility of incorporating the concepts together; what expertise is needed and work is needed to merge these topics. This concept will expand beyond plants into all ecological components.

7. Hire ecologist to help identify vegetative and benthic communities in coastal environments.

Identification of these communities maybe a difficult task due to the complexity and dynamics of the ecology of these systems and the difficulty of making those assessments with a meter or two of water. Coastal ecologists still have much to learn of the environments of these soils. While funding of ecologists come from different funding sources within the agency, others support the need for hiring more soil scientists trained in coastal pedology for mapping and data collection.

8. SUURGO certification of products and posting on Web Soil Survey and Soil Data Mart: Coastal Lagoons of Washington Co., RI and Little Narragansett Bay, RI and CT

Completed survey areas: Little Narragansett Bay, Ninigret Pond, Quonny Pond, Sinipuxent Bay, Chincoteague Bay, Taunton Bay, Delaware Bay, Point Judith Pond, Cedar Key (New England and FL); Pacific Island Areas (5 soil surveys that have SAS identified). Plans are underway to get RI/CT areas into WSS by 2010.

Series have been established (Pishagqua, Southpoint, Baffin, Cyprus, Ilachetomel, Chia, Insak)

9. Interpretations – list and prioritize; what work is done to date; which interpretions can be completed immediately. Distribute via sharepoint.

10. NASIS - populate SAS datafields when available in next NASIS version; write interpretation scripts for properties of oxidized pH (presence of sulfidic materials), bottom type (moorings)